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Characterization of the Upper Slope Sand Dunes in the South China Sea and their Impact on Acoustic Propagation

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LONG-TERM GOALS

Understand, parameterize and predict the impact of physical mechanisms on acoustic propagation in the ocean environment.

OBJECTIVES

Numerically investigate the spectral and angular characteristics of acoustic propagation in the vicinity of the shelfbreak due to the presence of the large subaqueous sand dunes on the upper continental slope in the South China Sea (SCS), and in the presence and absence of the episodic trans-basin internal solitary waves (ISW) approaching the shelfbreak.

Continue analysis and modeling of, and publication based on the acoustic data collected during the 2007 NLIWI Acoustics field experiment.

APPROACH

Carry out a series of small field experiments in collaboration with Taiwanese colleagues on Taiwanese research vessels to perform an initial characterization of (a) the sand dunes in terms of their spatial distribution along the continental slope, changing morphology and rate of migration, and (b) the dispersive and anisotropic (3D) impact of the sand dunes on acoustic propagation in terms of operationally-meaningful statistical parameters (e.g. mean, variance and coherence of the transmission loss as a function of frequency, range and angle). Key collaborators are Drs. Ching-Sang Chiu (NPS), Chifang Chen and Andrea Chiu (National Taiwan University), Y.J. Yang (Naval Academy, Taiwan), and Linus Chiu and Ruey Chang Wei (National Sun Yat-sen University).

WORK COMPLETED

A short multibeam echosounder survey cruise was completed April 28-May 3, 2012 to investigate the spatial extent of the sand dune field on the continental slope.

Planning and preparation for the upcoming April 2013 cruise is ongoing. Our Taiwanese colleagues recently hosted a planning workshop in Taiwan during the week of Aug. 20, 2012. The scientific objectives, experimental design and logistical issues of the cruise have been discussed and are currently being addressed. Acoustic modeling efforts are underway to ensure optimal mooring placement during the field experiments to meet the scientific objectives.

RESULTS

The multibeam echosounder survey cruise this past spring revealed: (a) the sand dunes occupy water depths in excess of 800 m water depth; (b) dunes are found throughout the 200 m to 700 m depth zone, but most reliably in the 200 m to 400 m zone; (c) the sand dune crests are predominantly parallel to the transbasin wavefronts in the open areas away from seabed features (e.g. canyons); and (d) the sand dune orientations are modified by local bottom topography and local bottom currents, but apparently always perpendicular to the direction of the localized flow. Additional accomplishments of the survey cruise included: (e) the area of the 2007 cruise transect was mapped; (f) the area in which moorings will likely be deployed in 2014 was mapped; (g) the ASIAEX acoustic transects between the VLA and the easterly and westerly sources were mapped (large sand dunes along both transects were found on the shelf).

IMPACT/APPLICATIONS

This study will contribute to the foundational scientific knowledge required to (a) improve naval sonar system performance, based upon an understanding of the phenomenology and statistics of acoustic propagation in an environment having both sand dunes and ISW's. The dunes' location on the continental slope has profound implications on both active (i.e. increased reverberation from the continental slope for a surface ship operating in deeper water) and passive sonar (i.e. up/downslope propagation anomalies, angular dependencies, 3D effects, combined effects of the sand dunes and ISW's).

RELATED PROJECTS

None

PUBLICATIONS

Chiu, Linus Y.S., D. Benjamin Reeder, Yuan-Ying Chang, Chi-Fang Chen, Ching-Sang Chiu and James Lynch (2012), "Enhanced acoustic mode coupling resulting from an internal solitary wave approaching the shelf break in the South China Sea", *J. Acoust. Soc. Am.* (submitted).